

***Brackenridgia ashleyi*, a new species of terrestrial isopod from  
Tumbling Creek Cave, Missouri (Isopoda: Oniscidea: Trichoniscidae)**

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*Abstract.*—*Brackenridgia ashleyi*, a new species of troglobitic trichoniscid isopod, is described and illustrated from Tumbling Creek Cave, Taney Co., Missouri. The genus *Brackenridgia* was previously known only from the western United States and Mexico. The discovery of *B. ashleyi* in the Ozark Plateaus physiographic province extends the range of the genus over 800 kilometers to the northeast. This species is closest geographically to *B. cavernarum* and *B. reddelli* in Texas, but is morphologically more similar to *B. heroldi* in California. Despite the presence of large amounts of bat guano in the cave, *B. ashleyi* is not guanophilic. By not using the guano microhabitat *B. ashleyi* avoids many of the predators present in the cave community.

In the eastern United States troglobitic trichoniscid isopods have long been known from the karst areas of the Appalachian Valley and Interior Low Plateaus. From the caves of this region have been described six species of *Amerigoniscus* (or *Caucasonethes*, from which *Amerigoniscus* was split by Vandel 1950) and four species of *Miktoniscus* (Vandel 1950, 1965, 1978; Jass & Klausmeier 2001). Other genera of trichoniscids occurring in the eastern U.S. are *Androniscus*, *Haplophthalmus*, *Hyloniscus*, *Trichoniscus*, and *Trichoniscoides* (Leistikow & Wägele 1999, Jass & Klausmeier 2001), but within these the only species of significance in caves is *Haplophthalmus danicus*. This Mediterranean species is a widely introduced exotic in the U.S., where it frequents caves (Vandel 1965).

In the Ozark Plateaus Craig (1975) and Gardner (1986) reported undescribed trichoniscids in Missouri caves including Tumbling Creek Cave. This cave is inhabited by a diverse assemblage of troglobites, although several of the species remain undescribed. Motivation to describe these taxa was presented by a decline within the cave's ecosystem leading to listing of the

endemic hydrobiid Tumbling Creek Cave-snail *Antrobia culveri* as a federal endangered species (U.S. Fish & Wildlife Service 2001). Given this situation, there was a need for characterization of the fauna and specimens of the trichoniscid were collected for the purpose of preparing a description of the species.

Because of reports (Aley 1975, Craig 1975, Gardner 1986, U.S. Fish & Wildlife Service 2001) listing this species as *Amerigoniscus* (or *Caucasonethes*) the material considered herein was received with the presumption that it represented a species in that genus. Examination of the isopod proved this assumption was wrong as evidenced by: (1) antenna 1 with short, stout aesthetascs on the distal article, (2) pereopod 7 propodus with distinct distal tuft of setae, and (3) male pleopod 1 with vestigial endopod. These characteristics eliminated the species from *Amerigoniscus* (Vandel 1953, 1965, 1978; Schultz 1982, 1994).

Other North American genera for consideration were listed variously in the First Division Trichoniscinae by Vandel (1965) or Tribe Typhlotricholigiodini (Tabacaru 1993, Schultz 1994): *Brackenridgia*, *Typhlotri-*

*cholioides*, *Cylindroniscus* and *Mexiconiscus*. The morphological characteristics listed above for the Tumbling Creek Cave isopod are exhibited by *Brackenridgia* and *Cylindroniscus*. Schultz (1994) listed the following characteristics of *Cylindroniscus* that separate the genus from *Brackenridgia*: (1) an elongate, semi-cylindrical body, (2) antenna 2 that projects from the front of the cephalon, and (3) uropod basis with elongate endopod and exopod. *Cylindroniscus* has been reported from Cuba and Mexico, but is not known to occur in the United States (Schultz 1970). Although the separation of *Brackenridgia* and *Cylindroniscus* is not entirely distinct, the Tumbling Creek Cave trichoniscid seems most appropriately placed in *Brackenridgia*. The ten species now recorded from this genus occur from Missouri to California and into Mexico (Rioja 1950, 1951, 1955; Vandel 1965; Schultz 1984; Dearolf 1953) as presented in Fig. 1.

*Materials and methods.*—The isopods were placed on a glass slide in a drop of glycerin and appendages were dissected directly into the glycerin to produce temporary mounts. All drawings were made on a Leica compound microscope with an optical drawing tube. After completion all appendages were then replaced in microvials and stored in 70% ethanol. The geographic coordinates for the type-locality were recorded with a Garman Map76 GPS. Temperature readings in Tumbling Creek Cave were taken with a Taylor digital thermometer.

Family Trichoniscidae

*Brackenridgia* Ulrich 1902

*Brackenridgia ashleyi*, new species

Figs. 2–5

*Caucasonethes.*—Aley, 1975:1.

*Caucasonethes* sp.—Craig, 1975:4 [in part].

*Caucasonethes* n. sp.—Gardner, 1986:15 [in part, Tumbling Creek Cave record only];

U.S. Fish & Wildlife Service, 2001: 66804.

*Material examined.*—Missouri: Taney Co., Tumbling Creek Cave, 22 Apr 2001, Catherine and Thomas Aley, 2.8 mm holotype ♂ (USNM 1008288); same locality and collectors, 2.3 mm paratype ♂ (USNM 1008289), 25 Nov 2001; same locality, Julian J. Lewis and David Ashley, 2.7 mm paratype ♂ (USNM 1014382), 23 Apr 2003, same locality 21 Feb 1998, William Elliott, 2.2 mm paratype ♂. The first three specimens are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. under catalog numbers as noted. The Elliott collection is deposited in the Enns Entomological Museum, University of Missouri, Columbia.

*Description of male.*—Eyeless, unpigmented, longest 2.8 mm. Body about 2.8× as long as wide, dorsal surface covered with short, stout triangular spine-like setae. Head, anterior margin biconcave, rostral area broadly rounded. Pereonites with lateral margins with short, stout triangular spine-like setae and short setae; pereonite 1 directed cephalad, 5–7 directed caudad. Lateral margins of pleonites contiguous, telson with posterior margin produced, broadly rounded, with 4 small setae.

Antenna 1 with 5–6 short, stout aesthetascs on distal article. Antenna 2 flagellum with 5 indistinctly demarcated articles, distal article with longitudinally striated apical organ. Mandibles with well developed molar process. Right mandible with plumose setae between molar process and incisor, lacinia mobilis apically lobed. Left mandible with two plumose setae between pars incisiva/lacinia mobilis and molar process. Maxilla 1, endopod with 3 bladelike setae; exopod with 8 spine-like setae (4 dominant robust + 4 smaller). Maxilliped palp segmentation indistinct, basal article relatively narrow, not obscuring endite.

Pereopod 1, propodus with 6 subtriangular spine-like setae along outer margin. Pereopods 5–7 with row of stout spine-like



Fig. 1. Distribution of *Brackenridgia* species and source of records: (1) *B. ashleyi*, (2) *B. cavernarum* (Texas records—Vandel 1965, Mitchell and Reddell 1971; New Mexico record—Dearolf 1953, needs confirmation); (3) *B. reddelli* (Vandel 1965, Mitchell & Reddell 1971); (4) *B. sphinxensis* (Schultz 1984); (5) *B. heroldi* (Vandel 1965); (6) *B. bridgesi* (Vandel 1965, Reddell 1981); (7) *B. palmitensis* (Mulaik 1960); (8) *B. villalobosi* (Vandel 1965, Reddell 1981); (9) *B. acostai* (Vandel 1965, Reddell 1981).

setae along distal margin of carpus and merus (scales of Vandel 1965 or Schultz 1994). Pereopod 7 propodus with spine-like setae in row on outer margin leading to dense tuft of setae adjacent to junction of dactyl.

Pleopod 1, exopod with small spinules along lateral margin, tip simple, produced

into subtriangular structure with low, slightly produced knobs subapically; endopod vestigial, reduced to a subtriangular flange. Pleopod 2 endopod thin, elongate, tapering to a point; exopod about  $0.3\times$  length of endopod, small, subovate with one apical setule. Pleopods 3–5 undifferentiated. Uropods about  $1.5\times$  length of telson, about

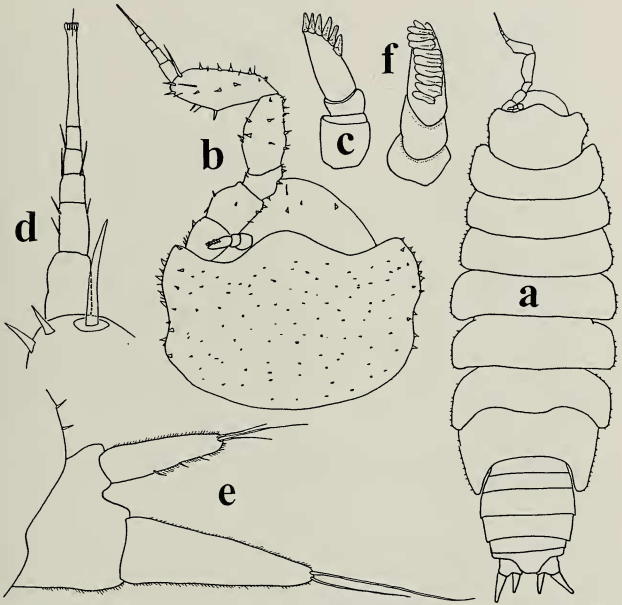


Fig. 2. *Brackenridgia ashleyi*, male from Tumbling Creek Cave, Taney Co., Missouri: (a) habitus, (b) head, labrum and antennae, (c) antenna 1 with aesthetascs, (d) antenna 2, (e) uropod; *B. reddelli*, male from Valdina Farms Sinkhole, Medina Co., Texas: (f) antenna 1 in situ.

0.3× length of pleon, endopod about 0.6× length of exopod, rami with 2–3 elongate apical setae.

*Etymology*.—The species is named in honor of Dr. David Ashley, of Missouri Western State College, in recognition of his years of outstanding effort monitoring the ecosystem of Tumbling Creek Cave.

*Distribution and ecology*.—*Brackenridgia ashleyi* is known only from the type-locality in the Springfield Plain of the Ozark Plateau physiographic province in south-

western Missouri. Tumbling Creek Cave has 2,815 meters of mapped passages formed in the predominantly dolomitic Jefferson City Formation of Ordovician age. The cave is on the property of the Ozark Underground Laboratory and has two entrances: (1) the natural entrance marked Bear Cave on the U.S. Geological Survey Protem Quadrangle map at N36.55471, W92.80275; and (2) an artificial entrance marked Tumbling Creek Cave at N36.54951, W92.80807. Tumbling Creek

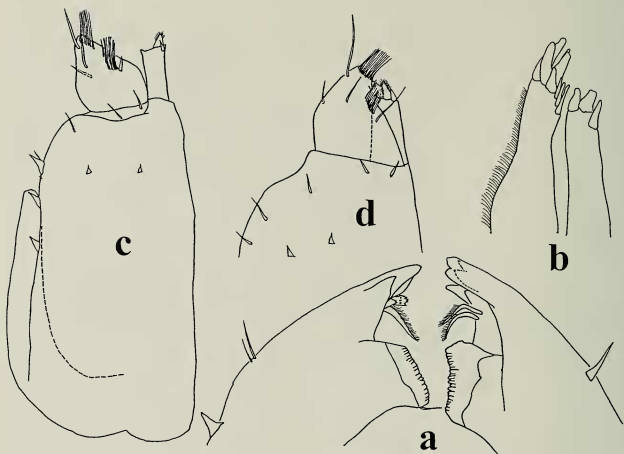


Fig. 3. *Brackenridgia ashleyi*, male from Tumbling Creek Cave, Taney Co., Missouri: (a) mandibles (b) maxilla 1, (c) maxilliped; *B. heroldi*, Crystal Cave, Sequoia National Park, California: (d) distal elements of maxilliped.

Cave was dedicated by the U.S. Department of the Interior as a Natural Landmark in 1980.

Tumbling Creek Cave has been the site of detailed ecological studies concerning the community associated with the bat guano of the Gray bat *Myotis grisescens* (Martin 1980, Fletcher 1982). Martin (1980) reported the air temperature of the cave was  $14.4^{\circ}\text{C}$  ( $\pm 1^{\circ}$ ) and relative humidity at or near 100%. Temperature measurements by Lewis and Ashley on 23 April 2003 of the substrate of the isopods were  $14.7^{\circ}\text{C}$  in the East Passage and  $14.3^{\circ}\text{C}$  in the main stream passage.

Martin (1980) reported 54 invertebrate taxa occurring on guano, bat carcasses and wood in Tumbling Creek Cave. Typical of caves with Gray bat maternity colonies, most surfaces between the bat roosts and

entrance are peppered with bat guano and piles as much as a meter deep occur in some areas. Martin found 49 taxa inhabiting these guano piles, several of which were predators, including the pseudoscorpion *Hesperocheles occidentalis*, an unidentified harvestman, and beetles *Platynus tenuicollis*, *Bembidion* sp. and *Atheta* sp. In contrast, the terrestrial isopods were never found on guano nor bat carcasses, only wood. Of the 14 species recorded from wood by Martin, only *B. ashleyi* and the millipeds *Pseudopolydesmus pinetorum* and *Scoterpes* s. latu *dendropus* did not also occur on guano or carcasses. This habitat partitioning by these species excluded them from the richest food source in the cave, but eliminated significant predation pressure as well. A fact not appreciated by Martin, who did not identify the terrestrial isopods, was

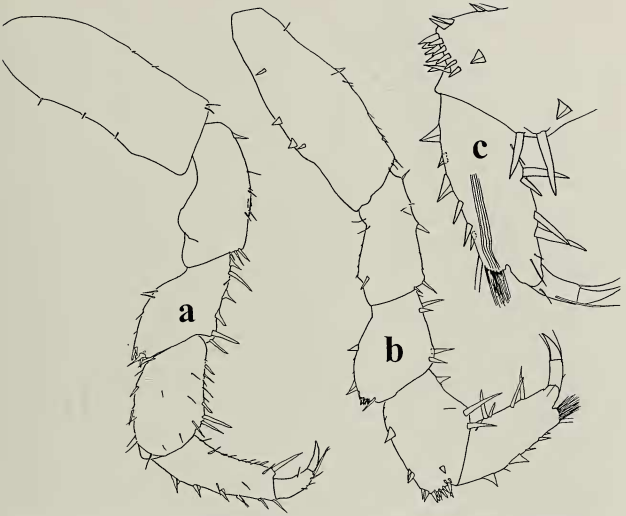


Fig. 4. *Brackenridgia ashleyi*, male from Tumbling Creek Cave, Taney Co., Missouri: (a) pereopod 1, (b) pereopod 7, (c) pereopod 7 propodus and dactylus.

that the exotic *Haplophthalmus danicus* was also living on the wood and therefore possibly competing with *B. ashleyi*.

The wood on which the isopods were most easily observed consists of pieces of pine boards placed in the cave to attract invertebrates for viewing purposes (the cave is operated among other things as an educational facility). The isopod presumably feeds on microbial decomposers occurring on the wood. As the presence of the wood is artificial, under natural circumstances *Brackenridgia* must live on the ubiquitous mud banks. All of the isopods collected for study herein were found associated with wood on relatively dry mud banks along the main stream passage or in the upper level East Passage. When observed, *Bracken-*

*ridgia* moved about within an area of a few square centimeters, with its antennae actively probing the environment when walking.

*Life history.*—Nothing is known of the reproduction of *B. ashleyi*. In examining material of other *Brackenridgia* two ovigerous females of *B. heroldi* were found in a collection from Hurricane Crawl Cave, Sequoia National Park, California (collection date unknown). One was a 3.2 mm specimen with four embryos in the brood pouch. The other was 3.5 mm in length and was carrying one 1.1 mm juvenile.

*Discussion.*—With the exception of the humicolous *B. heroldi*, the species of *Brackenridgia* are troglobites restricted to karst areas isolated from one another by

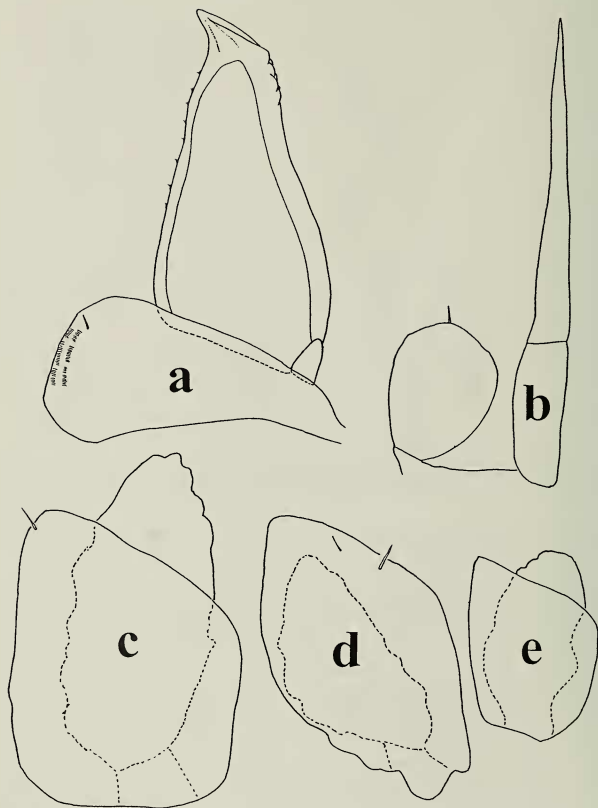


Fig. 5. *Brackenridgia ashleyi*, male from Tumbling Creek Cave, Taney Co., Missouri: (a) pleopod 1, (b) pleopod 2, (c) pleopod 3, (d) pleopod 4, (e) pleopod 5.

hundreds of kilometers of non-cavernous rocks. Dispersal and gene flow between populations is thus very unlikely, leaving little doubt as to the speciation of these animals in their respective karst islands. For example, *B. ashleyi* in the Ozarks is separated from its nearest relatives inhabiting the karst of the Balcones Fault Zone in Texas (*B. cavernarum* and *B. reddelli*) by over 800 kilometers (Fig. 1).

That notwithstanding, the morphological expression of this speciation is conservative among the members of the genus. The subtriangular shape of the male first pleopod exopod is similar in all species of the genus. The species of *Brackenridgia* can be separated from one another by relatively small differences in the structures present at the tip of this exopod. In the most primitive species, e.g., *B. cavernarum* or *B. sphinxensis*, the exopod tip is undifferentiated. A variety of specializations into spinose or digitiform structures occur in *B. reddelli*, *B. ashleyi* and *B. villalobosi*, with the bi-spinose pleopod 1 exopod tip (Vandel 1965) of *B. bridgesi* presumably apomorphic. Although *B. ashleyi* is closest geographically to *B. cavernarum* and *B. reddelli* in Texas, the slight modification of the pleopod 1 exopod tip is more similar to that of *B. heroldi* in California.

Much work remains in the systematics of *Brackenridgia*. In *B. reddelli* and *B. sphinxensis* none of the mouthparts have been illustrated. The latter species is known from a single tiny dissected specimen so there is little hope for a better understanding of the species without additional collecting. Similarly, *B. palmitensis* (Mulaik 1960) remains unidentifiable (Vandel 1965) and attempts to collect a male have been unsuccessful (Reddell 1981). The regional variation reported by Vandel (1965) for *B. reddelli* is suggestive of a cluster of closely related species inhabiting the caves associated with the Balcones Fault Zone in Texas. Confusion has also been created by Vandel's (1965) interpretation of the lateral margin of the male pleopod 1 protopod of

*B. villalobosi* (illustrated by Rioja 1950 fig. 44) as the exopod tip.

Vandel (1965) published a key to the species of the genus known at the time, while Rioja (1955) included only the Mexican fauna. I have updated these works to encompass nine members of the genus, including the addition of *B. sphinxensis* and *B. ashleyi*, but excluding *B. palmitensis*. The identity of *B. palmitensis* remains obscure, although Mulaik (1960 fig. 43) illustrated 8 short, stout aesthetascs on the distal article of antenna 1. This characteristic separates this species from the majority of *Brackenridgia* species, including *B. ashleyi*.

Key to Species of the Genus  
*Brackenridgia*

- 1a. Pereonites with prominent tubercles (fig. 6a), antenna 1 with elongate aesthetascs . . . . . *B. acostai* (caves, Chiapas, Mexico)
- 1b. Pereonites without prominent tubercles (fig. 2a) . . . . . (2)
- 2a. Male pleopod 1 exopod tip undifferentiated (fig. 6b) . . . . . (3)
- 2b. Male pleopod 1 exopod modified, tapering to 1-2 processes (figs. 5a, 6c, d) . . . . . (4)
- 3a. Length excluding antennae and uropods <2 mm; antenna 1 distal article with 5 aesthetascs . . . . . *B. sphinxensis* (Sphinx Cave, Cochise County, Arizona)
- 3b. Length excluding antennae and uropods >4 mm; antenna 1 distal article with 10+ aesthetascs . . . . . *B. cavernarum* (caves, southcentral Texas, unconfirmed in southeastern New Mexico)
- 4a. Male pleopod 1 exopod tapering to a single point (figs. 5a, 6c) . . . . . (5)
- 4b. Male pleopod 1 exopod tip with two processes (fig. 6d) . . . . . (7)
- 5a. Male pleopod 1 exopod tapering to a digitiform process, antenna 1 aesthetascs 8 . . . . . *B. villalobosi* (caves, Veracruz)
- 5b. Male pleopod 1 exopod tapering to a point (figs. 5a, 6c), antenna 1 aesthetascs 5-6 (fig. 2c) . . . . . (6)
- 6a. Maxilliped palp basal segment broad, obscuring endite (fig. 3d); male pleopod 1 exopod without subapical knobs (fig. 6c) . . . . . *B. heroldi* (humus and caves, southern California)



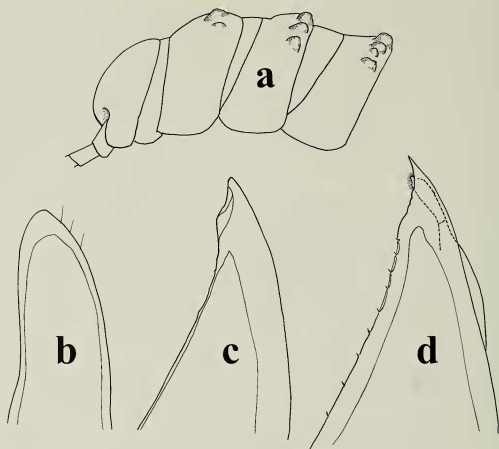


Fig. 6. *Brackenridgia acostai*, Cueva del Ticho, Chiapas: (a) head and pereonites 1-3; *B. cavernarum*, Kappelman Salamander Cave, Comal Co., Texas: (b) pleopod 1 exopod tip; *B. heroldi*, Crystal Cave, Sequoia National Park, California: (c) pleopod 1 exopod tip; *B. reddelli*, Valdina Farms Sinkhole, Medina Co., Texas: (d) pleopod 1 exopod tip.

- 6b. Maxilliped palp basal segment narrow, not obscuring endite (fig. 3c); male pleopod 1 exopod with low, subapical knobs (fig. 5a) . . . . . *B. ashleyi* (Tumbling Creek Cave, Missouri)
- 7a. Male pleopod 1 exopod tapering to two acute spines, antenna 1 aesthetascs 14 . . . *B. bridgesi* (caves, northeastern Mexico)
- 7b. Male pleopod 1 exopod tapering to an acute spine and a second brush-like process (6d); antenna 1 aesthetascs 9-10 (fig. 2f) . . . . . *B. reddelli* (caves, southcentral Texas)

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